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Circularity, entropy, ecological conflicts and LFFU

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ABSTRACT

The economy is not circular, it is increasingly entropic. Energy from the photosynthesis of the distant past, fossil fuels, is burned and dissipated. Even without further economic growth the industrial economy would need new supplies of energy and materials extracted from the “commodity frontiers”, producing also more waste (including excessive amounts of greenhouse gases). Therefore, new ecological distribution conflicts (EDC) arise all the time. Such EDCs are often “valuation contests” displaying incommensurable plural values. Examples from the Atlas of Environmental Justice are given of coal, oil and gas-related conflicts in several countries combining local and global complaints. Claims for climate justice and recognition of an ecological debt have been put forward by environmentalists from the South since 1991, together with a strategy of leaving fossil fuels underground (LFFU) through bottom-up movements. This could make a substantial contribution to the decrease in carbon dioxide emissions.

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1. Introduction: the circular economy gap

The concept of “circular economy” implies that material resources could be increasingly sourced from within the economy, reducing environmental impact by increasing the reuse and recycling of materials. The aim would be to minimise waste and move towards a closed-loop economy. However, this socio-technical “imaginary” has no relation to reality as revealed by biophysical, metabolic analysis. Estimates for the EU-27 economy are that only around 12% of the material input was recycled in 2019 (Strand et al. 2021). This paper discusses some implications of this enormous “circularity gap” or “metabolic rift” – more an abyss than a bridgeable gap. The industrial economy is not circular, it is entropic (Haas et al. 2015, 2020; Giampietro and Funtowicz 2020), therefore it produces polluting waste, and it requires new supplies of energy and materials extracted from old and new “commodity frontiers” (Moore 2000; Joseph 2019; Gerber 2020; Hanáček, Kröger, and Martinez-Alier 2022). Therefore, ecological distribution conflicts arise. The resistance movements born from such conflicts may help to move the economy in a less unsustainable direction (Scheidel et al. 2018).

The reality is that the decrease of biodiversity continues as the HANPP (human appropriation of net primary productivity) increases due to meat consumption, “biofuels”, and wood and paper pulp production (Temper 2016), while the world input of inorganic and organic materials to the economy (measured in tonnes) still goes up (until 2020) (Krausmann et al. 2018). True, peak CO₂ emissions and peak extraction of some materials (including coal and oil but not yet natural gas) might be reached soon but descent from the high peaks will be slow. Moreover, even a non-growing industrial

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economy would require continuous new inputs of energy and materials from the commodity extraction frontiers because energy is not recycled, and materials are recycled only to a small extent.

At a time in which despite all the evidence to the contrary there is much enthusiasm about the possibilities of an industrial circular economy, it is necessary to explain the two senses in which authors write about the “circular economy”, a term that comes from introductory microeconomics and more from chemical engineering and industrial ecology. Introductory microeconomics is often taught in terms of what Georgescu-Roegen called “the merry-go-round” between consumers and producers (Georgescu-Roegen 1975), a circular scheme in which producers put goods and services in the market at prices which consumers pay; meanwhile, consumers (as providers of labour, land or other inputs or “factors of production”) get money from producers in the form of salaries, rents etc. and they buy, as consumers, the products or services that have been produced. The “merry-go-round” needs energy for running (energy which gets dissipated), and it produces material waste which is not recycled. For instance, coal and oil are not really produced (contrary to textbook economics), they are merely extracted, and their energy is dissipated by burning which causes excessive amounts of carbon dioxide. This is left aside in introductory mainstream economics, or maybe it is introduced much later, in the analysis of the “intergenerational allocation of exhaustible resources” and in the treatment of externalities which are “internalized into the price system”.

As ecological critics of mainstream economics since the 1970s and 1980s, we thought that we were slowly convincing the public, if not the professional economists, that the “merry-go-round” representation of the economy was wrong. The economy is embedded in physical realities. However, to our surprise, the recent novelty is that, from industrial ecology and not only from economics, a circular vision of the economy is also preached. The biochemical circles of carbon and other elements, the great water cycle driven by sun energy, and the geologically produced energy and the materials entering the economy are here taken into account, and the waste is very much present, but it is assumed that technical change may close the economic circle. The waste becomes inputs. The energy (dissipated, of course, because of the Second Law of Thermodynamics) is not a problem because it will come from current sun energy (not fossil fuels, which are exhaustible stocks of photosynthesis from the past). The circular supply chain is supposed to rule physically in the economy. We know however that the actual degree of the circularity of the industrial economy is very low, and it is probably decreasing as formerly biomass-based economies complete their transition to an industrial economy based on fossil fuels in India and Africa (Roy and Schaffartzik 2021).

2. Commodity frontiers

There is a huge “circularity gap” between the “fresh” material input and the recycled material input into the economy. At the world level, the first is about 92 Gt per year and the second about 8 Gt. Let us assume that the world economy grows slowly and merely doubles the material input requirement in 70 years. Of the material input of 200 Gt let us assume that 100 Gt are recycled. An enormous improvement in the recycling rate from 8% to 50%, and however still a small increase (from 92 Gt to 100 Gt) in the “fresh” material input required every year. The so-called Circularity Gap Report (based on calculations in Haas et al. 2015, 2020) asserts that 92 Gt of virgin resources were extracted in 2017 and only 8.6% of all materials used were recycled.¹ If less than 10% of materials (including the energy carriers) are recycled, where do the other 90% come from? My answer is: from the new commodity extraction frontiers and also to some extent from customary sources. Thus aluminium may come to some extent from recycling, it may come from bauxite from old mines which are used more intensively, or it may very likely come from new bauxite mines. The EJAAtlas records almost 50 conflict cases (by January 2021) on bauxite/aluminium.

There is a new collective initiative for the historical study of “commodity frontiers” and also a new journal with this title (<https://commodityfrontiers.com/journal/>). This concept (Moore 2000) is becoming ever more relevant. The industrial economy marches all the time to the extraction frontiers in search of materials and it also travels to the waste disposal frontiers. The waste is sometimes

deposited anywhere (solid or liquid waste, or GHG), and sometimes a small part of it is economically valued again by recyclers, or in controversial REDD schemes for “capturing” carbon dioxide (Schindler and Demaria 2020). Both the expanding commodity extraction frontiers and the waste disposal frontiers are often inhabited by humans and certainly by other species. Hence the growth in the number of conflicts over the use of the environment, and as a response the growing strength of the environmental justice movement (Martinez-Alier 2021).

Two processes of growth and changes in the socio-metabolism are associated with the commodity extraction frontiers: commodity-widening and commodity-deepening (Banoub et al. 2020). The first implies the spatial extension of nature appropriation, via territorial claims to the control and use of natural resources and associated acts of dispossession. The second implies the intensification of exploitation at existing sites, through socio-technical innovation and new investments in the same location (commodity-deepening) as for instance the mining of metal ores or coal by open-cast techniques discarding previous subterranean mining, or gas or oil fracking, or energy-intensive fishing or plantation agriculture.

3. Ecological distribution conflicts (EDC) and valuation contests

The EJAtlas (www.ejatl.org) is basically an archive of EDCs that took place in the last decades or are taking place now at the commodity extraction frontiers or at the waste disposal frontiers (Temper et al. 2015, 2018, 2020; Scheidel et al. 2020; Martinez-Alier 2021). It is a database of environmental justice conflicts made available for research, teaching, networking, and advocacy, housed at the Institute of Environmental Science and Technology (ICTA) at the Universitat Autònoma de Barcelona. Since 2012, academics and activists collaborate to write the entries, reaching 3500 by July 2021, a large sample from a much larger unknown number of conflicts. The EJAtlas is a product of the grassroots counter-movement for environmental justice, and at the same time a tool for researching its recent history and reinforcing its presence across world regions and cultures. The EJAtlas registers the iconography of such conflicts displayed in striking banners and theatricality (Sanz and Rodriguez-Labajos 2021). It provides descriptions and coded variables for research on comparative, statistical political ecology (Scheidel et al. 2020). One of the EJAtlas’ main purposes is lifting the curtain of invisibility over movements for environmental justice or “liberation ecologies” (Peet and Watts eds 2004) contributing to what Sousa Santos calls a “sociology of absences”.

The industrial economy was still growing until 2020. There is a transnational expansion of the agribusiness frontiers, otherwise known as “land grabbing” in the search for new forms of biomass as for instance cattle pasture, soybeans, sugar cane, palm oil, wood and paper pulp. Resistance in such places is often expressed as a defence of the commons (Dell’Angelo et al. 2021). There is also search for fossil fuels. Even a stagnant economy would cause conflicts. For instance, if the world economy is extracting and eventually burning today 100 million barrels of oil, tomorrow it will do the same or a little bit more or less at the commodity frontiers for oil. If “peak oil” is reached (as it happens in particular locations and might soon happen at world level), then some oil is substituted by natural gas or by coal. This is why there are so many EDCs (in extraction, transport and waste disposal - including those caused by the excessive amounts of CO₂), and hence also so many movements of resistance at the commodity extraction and waste disposal frontiers. Substitution of fossil fuels by hydropower or biomass fuels, or wind-wills and solar panels causes conflicts because of the land and minerals requirement (Temper et al. 2020). Sometimes, the attempts to “valorize” the waste also cause new types of conflicts - as for instance the breaking up of old ships in Alang (India), Chittagong (Bangladesh), Gadani (Pakistan), or when burning industrial or domestic waste in urban incinerators or in cement kilns causing new EDCs. Using non-fossil fuels might help to decarbonize the economy and increase its circularity. Yet the material and energy needs of such technologies, their human health and livelihood implications must be considered.

The term Ecological Distribution Conflicts (EDCs) was coined and introduced in ecological economics by Martinez-Alier and O’Connor (1996, 2002) to describe social conflicts born from the unfair

access to natural resources and the unjust burdens of pollution (Beckenbach 1992; O'Connor 1993; Martinez-Alier 1993; 1995). We could classify EDCs through the stages of a commodity chain; at the extraction of energy carriers or other materials, the transportation and the production of goods, or the final disposal of waste. Environmental benefits and costs are distributed in a way that causes conflicts along the commodity chains, accompanied by different forms of violence against environmental defenders (Navas et al. 2018; Scheidel et al. 2020; Tran et al. 2020). The terms socio-environmental conflict, environmental conflict or EDC are interchangeable. Trained as economists, we were inspired by the term “economic distribution conflicts” in political economy that describes conflicts between capital and labour (profits vs. salaries), or conflicts on prices between sellers and buyers of commodities, or conflicts on the interest rate to be paid by debtors to creditors. The term EDC stresses instead the idea that the unequal or unfair distribution of environmental goods and damages is not always coterminous with “economic distribution” as, for instance, rents paid for by tenant farmers to landlords, or the international terms of trade of the Brazilian economy or claims for higher wages from mining unions opposing company owners. In the EJAtlas as in real life we find many examples of valuation struggles (e.g. Zografos and Martinez-Alier 2009; Temper and Martinez-Alier 2013). The plural values displayed by participants in such conflicts are often incommensurable, they cannot be reduced to a single unit (contrary to doctrines of economic compensation for negative “externalities”). “Plural values” as a foundation of ecological economics link well with the notion of “multidimensional poverty” (Gamboa, Mingorria, and Scheidel 2020).

EDCs is then a term for collective grievances and claims against environmental injustices. For instance, a factory may be polluting a river (which belongs to nobody or belongs to a community that manages the river – as studied by Ostrom (1990) and her school on management of the commons). At another scale, this happens with climate change, causing perhaps perceptible sea level rise in some Pacific islands or in the Kuna islands in Panama or in Kivalina or Shishmaref in Alaska² or causing glacier melting in the Andes. Yet this damage is not valued in the market and those impacted are not compensated for. Sometimes, economic compensation is excluded not only because of the strong reluctance by corporations and rich countries to accept their “environmental liabilities” but also because of the nature of the values in question. Unfair ecological distribution is inherent to capitalism, defined by K. W. Kapp (1963) as a system of cost-shifting. In environmental neoclassical economics, the preferred terms are “market failure” and “externalities”, a terminology that implies that such externalities could be valued in monetary terms and internalized into the price system. If we accept economic commensuration and reject incommensurability of values (Martinez-Alier, Munda, and O'Neill 1998), “equivalent” eco-compensation mechanisms could be introduced. Instead, ecological economics and political ecology advocate the acceptance of different valuation languages to understand such conflicts and the need to take them into account through genuine participatory processes which are difficult to accept and implement because of social barriers and unequal power (Agarwal 2001; Zografos and Howarth 2010).

If damaged for instance by industrial pollution from lead or asbestos or by coal dust, the local populations will perhaps first claim that children's health has no price, that the pollution should stop forthwith and the guilty business executives should be punished by prison. But after a few years, once the social and legal battles have been lost, the local people relatively poor and powerless will perhaps meekly ask for and accept a monetary compensation. This also applies to people displaced by dams: they may argue in terms of livelihood and ecological values against the dam, they might claim indigenous rights over the river and also declare it as sacred. Once the battle is lost, once some leaders have been killed, what other alternative remains for them but to accept some money? (Del Bene, Scheidel, and Temper 2018). Political ecology and ecological economics nevertheless advocate the acceptance of different valuation languages to understand such conflicts (Saes and Bisht 2020). Who has the power to reject valuation languages such as sacredness, livelihood, rights of nature, indigenous territorial rights, archaeological values, and ecological or aesthetic values in their own units of account? Who gives to the language of economics and to mainstream economists the power they have? (Martinez-Alier 2002).

Political ecology studies EDCs, and it puts biophysical reality (increased material and energy flows, climate change, increased HANPP and loss of biodiversity) at the centre of politics. Instead, mainstream environmental sociology, political science and neoclassical environmental economics still hold fast to Inglehart's (1995) notion that "the poor are too poor to be green". Environmentalism is supposed to grow in the so-called "post-materialist" affluent societies, and ecological modernization and technological improvements will hopefully come to the rescue with increasing incomes making pollution follow a "Kuznets curve" and also achieving at least relative dematerialization of the economy. Moreover, the environment will improve by public policies. Bottom-up protests are deemed irrelevant or marginalized and repressed.

However, there are local as well as global distribution conflicts; and many of them occur between the global South and the global North (for instance, a Canadian or Chinese mining company operating in Peru) while others are local conflicts within a short commodity chain (e.g. on local sand and gravel extraction for a nearby cement factory) (Bisht 2021). Research on EDC links up with several concepts in ecological economics, political ecology and related disciplines: the growing and changing social metabolism at world level, the ecologically unequal trade (Muradian and Martinez-Alier 2001; Hornborg and Martinez-Alier 2016), the growing ecological debt from North to South (Warlenius, Pierce, and Ramasar 2015), the international and local resistance against environmental injustices, the acknowledgment of environmental liabilities; also social ecofeminism that highlights gender in the study of environmental impacts and activism (Agarwal 1992), the notion of environmental justice as a term born in the U.S.A. from the struggle against "environmental racism" (Bullard 1990, 1993; Bullard and Johnson 2000), and the environmentalism of the poor and the indigenous (Guha and Martinez-Alier 1997, 1999).

4. Climate justice and Blockadia actions to "keep it in the ground"

There is a world movement for environmental justice (Newell and Sikor 2014; Raphael 2019; Temper 2018), a counter-movement against the exploitation of raw materials and the disposal of waste based on local instances of resistance (as recorded in the EJAtlas and other sources). In the rest of the paper, I shall focus on the resistance against fossil fuels extraction and burning. Quite often "just energy transitions" are discussed in terms of compensation to be given in exchange for keeping fossil fuels in the ground to miners and other workers in the fossil fuel industries, or to relatively poor consumers (such as the *gilets jaunes* in France), or to countries and companies that will suffer losses from such "stranded assets". Here we take a different perspective. As argued in a review article in *Development and Change* (Martinez-Alier 2015) there is a top-down, public policy view of climate justice, and a bottom-up view (also Schlosberg and Collins 2014).

The discourse of climate justice was first put forward as a complaint against climate change from the South in 1991 from Delhi, India, even before the Rio de Janeiro conference of 1992. Anil Agarwal and Sunita Narain from the Centre for Science and Environment published a powerful pamphlet on climate injustice titled *Global warming in an unequal world: a case of environmental colonialism*. They calculated the per capita figures on emissions showing an obvious fact: if the carbon dioxide emissions by impoverished countries (in history and at present) would have been the universal norm, there would be no enhanced greenhouse effect. The oceans and the new photosynthesis would absorb all the carbon dioxide emissions caused by humans. The increasing concentration of carbon dioxide in the atmosphere (around 300 ppm in 1900, 360 ppm in 1992, 420 ppm today in its march to 450 ppm before 2050) is caused by the "luxury" emissions of the rich, and not by the "survival" emissions of the poor.

It would not be right to ask poor people to decrease their emissions, which they could only do by giving up meagre meals cooked with fuel wood or dung, or by breathing more slowly or not at all. The reduction effort should be made by the rich. There are great differences in the use of energy between people. We all need a minimum of energy as food energy ("endosomatic" use energy, as Alfred Lotka said, or "vital energy" as Frederick Soddy, the Nobel Prize in chemistry,

wrote in his books on energy and the economy in the 1920s) (Martinez-Alier and Schlüpmann 1987). We all need also some “exosomatic” energy. Many people in the world must and will increase further their energy use.

Excessive emissions of greenhouse gases imply a unilateral appropriation of sinks, whether they are new vegetation, the oceans or the atmosphere as a temporary deposit. Bottom-up activism could take the form of court cases and demands from the South for repayment of the ecological debt and/or the climate debt since 1992 until today (Warlenius, Pierce, and Ramasar 2015) (including payments for “loss and damage”, in the official parlance of the COPs). Using the climate debt or in general the ecological debt to pressure on the rich countries to reduce emissions would be the best contribution from the global South to the negotiations. Bottom-up activism by non-governmental direct actions can be effective, as explained in the next section.

Naomi Klein’s book of 2014 *This Changes Everything* was a powerful call from Canada for reinforcing the global grassroots movement for climate justice that already existed. Naomi Klein learnt about the climate debt in 2009 from the young Bolivian ambassador to the UN in Geneva, Angelica Navarro. She also quotes Sunita Narain saying, “I am always being told – especially by my friends in America – that ... issues of historical responsibility are something we should not talk about”. Klein believes in the environmentalism of the poor and the indigenous much more than in the environmentalism of the Big Green organizations. Her book was written following the methodology of action-research. It explains her forays up to the barricades and blockades against open-cast gold mining in Greece by the Canadian Eldorado company and against shale gas fracking in Romania by Chevron, against oil pipelines in Canada, and into the marshes of Louisiana to inspect the damage from the BP spill.

Drawing on the reports of EJOLT (Environmental Justice Organizations, Liabilities and Trade) and other sources (Temper et al. 2013), Naomi Klein reconstructed the story of the proposal to leave oil in the soil in Ogoniland in the Niger Delta and in the Amazon of Ecuador, and the founding of Oilwatch in 1995 which combined local resistance to the fossil fuels with emphasis on the “unburnable fuels” that should be left untouched if increased concentration of carbon dioxide in the atmosphere is to be avoided. The idea of “keep it in the ground” (“leave oil in the soil, leave coal in the hole”, LFFU, leave fossil fuels underground) was built on community resistance movements to fossil fuel extraction and on non-governmental and non-academic research and advocacy. Extreme violence by the military in collaboration with the Shell corporation caused many victims in the Niger Delta while the Texaco-Chevron disaster in the northern Amazon region of Ecuador was well documented. From the mid-1990s Oilwatch explicitly added the argument of climate change to the reasons to leave oil in the soil (Bassey 2009). In the EJOLT project (2011–2015) we used the words Yasunization and Ogonization to acknowledge that LFFU proposals came from Nigeria and Ecuador (Temper et al. 2013).

Naomi Klein’s book included travel to the Alberta oil sands devastation and participation in the “cowboy and Indian” resistance to the Keystone XL and other pipelines. It shows the resistance movements against fracking in France and elsewhere (because of methane emissions, and local harm to water and landscapes), and also the resistance to mountain top coal removal in Appalachia. She adopted the word “Blockadia” for the instances on grassroots opposition to the extraction and transport of fossil fuels that she picked up in her travels. As so often, terms of the environmental justice movement are introduced by activists, not by academics (Martinez-Alier et al. 2014). “Blockadia” is a grassroots word while LFFU is more academic. Klein called for a movement to place climate change at the centre of politics, “the thing that changes everything”. According to her, and I agree, the historical and urgent task of decreasing greenhouse gas emissions falls on the many grassroots movements that form networks drawing their strength from the battles on the ground against the private or public fossil fuel companies, against coal mines, oil wells, their pipelines and sea carriers, refineries and thermal power stations (Temper et al. 2020).

One year after Naomi Klein’s book was published with a resounding call for climate justice, the Paris international agreement of December 2015 explicitly excluded the notion of liability. Literally the agreement “does not involve or provide a basis for any liability or compensation”. Otherwise, the

governments of the rich countries would not sign any agreement. Over many years, Ambassador Todd Stern of the U.S.A. was a spokesman for the rich countries against the recognition of liability for climate change. Some voices were heard in favour of applying “strict liability” as in domestic environmental legislation in the U.S.A. and the EU (CERCLA) (Bhagwati 2010) but it was argued Godard (2012) that insistence on the Ecological Debt was counter-productive because it might lead to a failure in getting any international agreement. In Paris, this travesty of justice (i.e. the leaving aside of the Ecological Debt) won the acquiescence of all the world governments after Pablo Solon (Bolivia’s ambassador at the COPs on climate change in Copenhagen (2009) and Cancun (2010)) and a few recalcitrant representatives of other governments were forced into colonial submission. In some cases officials from countries of the South were allegedly bribed into acquiescence.

Not everybody is convinced. Some competent academic voices (Warlenius, Pierce, and Ramasar 2015) continue to calculate the “sinks appropriations”, i.e. the disproportionate use by rich people of the atmosphere, the oceans, and new vegetation to freely dump excessive emissions of carbon dioxide. Warlenius argues strongly in favour of assigning payments in proportion to historical responsibility. After all the international environmental rhetoric includes the polluter pays principle. However, fines would be more appropriate than payments (or taxes) because fines imply that you should not do the wrong action again. There are also non-academic voices pointing to the ecological debt from North to South as stated explicitly in paragraph 51 of the Encyclical “Laudato si” of 2015 which however did not quote Agarwal’s and Narain’s CSE leaflet published in Delhi in 1991 or Naomi Klein’s book, or any of the many academic or militant papers on the ecological debt.

A true “ecological debt” exists, particularly between the global north and south, connected to commercial imbalances with effects on the environment, and the disproportionate use of natural resources by certain countries over long periods of time. The export of raw materials to satisfy markets in the industrialized north has caused harm locally, as for example in mercury pollution in gold mining or sulphur dioxide pollution in copper mining. There is a pressing need to calculate the use of environmental space throughout the world for depositing gas residues which have been accumulating for two centuries and have created a situation which currently affects all the countries of the world. The warming caused by huge consumption on the part of some rich countries has repercussions on the poorest areas of the world ...

4.1. “Unburnable fuels”: glocal movements for climate justice

The bottom-up position for climate justice is strongest when local arguments for LFFU come together with a global perspective of the need to decrease GHG emissions (Anguelovski and Martinez Alier 2014). This confluence between local grievances and environmental issues happened in India in the last few years with the global youth movement Fridays for Future, within which there was a debate on whether to join other human rights movements and economic grievances, or stick to climate change only. The Farmers’ movement in Punjab in 2020 decided the issue (with the collaboration of the Indian police that arrested Disha Ravi and other activists from Fridays for Future, for supporting the Farmers’ movement). The slogan “fund farmers, defund coal” was raised on cardboard, a defiant performative symbol (Figure 1).

Grassroots opposition to oil extraction started before the general awareness of climate change. In 1997, the network Oilwatch born from the disastrous experience over thirty years with oil extraction in the Amazon of Ecuador by Texaco-Chevron (one of Acción Ecológica’s first campaigns) and by Shell in the Niger Delta in Nigeria (as experienced by the Ogoni and ERA, Environmental Rights Action), proposed in the parallel COP meeting in Kyoto a moratorium on oil exploration and extraction in socially and ecologically sensitive locations (Temper et al. 2013). The slogan “leave oil in the soil” (later followed by “leave coal in the hole”) was raised in 1997. Little happened for ten years in public policy in Ecuador until some ministers of President Correa’s new government in 2007 in Ecuador (Alberto Acosta, Fander Falconí, Maria Fernanda Espinosa) took the initiative (coming



Figure 1. Fridays for Future in India. Source: <https://www.thenewsminute.com/article/fridays-future-was-govt-radar-long-disha-ravis-arrest-inside-view-143502>

from civil society organizations) to leave in the ground the oil from the Yasuní ITT fields, deep into the Amazon (Martinez-Alier and Temper 2007). This has inspired many other LFFU movements. Although the government was divided, the proposal was alive for six years, until President Correa (who never was favourable to it) dropped it in August 2013 refusing to become a leader from the South on climate change. Also, Evo Morales of Bolivia had refused to take this leadership. His government with Pablo Solón as representative in the Copenhagen COP in 2009 and still in Cancún in 2010 complained forcefully against climate injustice, asking for recognition of the ecological debt. But internally in Bolivia, the anti-environmental group led by vice-president García-Linera boycotted the international position of Bolivia as a leader on climate change by conspicuously deciding to open the Amazon territory through a new road in the TIPNIS territory (Temper et al. 2013).

The leadership of the grassroots movements passed to other hands. Some belong to the young people's movements for Climate Justice coming from the North represented by Greta Thunberg, speaking for the next generations. Meanwhile, the local opposition to fossil fuels extraction to which climate change arguments are added, continues to grow with some success in the South but also in the North as in the following 12 LFFU examples fully referenced in the EJAtlas. My examples are different from those collected by Hilson 2020, in her University of Amsterdam's thesis on ten successful instances of LFFU based on information provided by the EJAtlas.³

4.1.1. Coal related conflicts

In this photo (Figure 2) taken in December 2017, members of militant and indigenous peoples' groups staged a protest in front of the South Cotabato provincial Capitol in Koronadal City to



Figure 2. Against coalmining in South Cotabato, Philippines. Source: Bong S. Samiento. <https://ejatlas.org/conflict/coal-mining-in-barangay-ned-south-cotabato-philippines>.

oppose open cast coal mining and condemn the killing of tribal leaders in the province. Two thousand hectares for mining were going to be used by the San Miguel Corporation to take out about 27 million tons of coal, a clear case of “commodity widening” (expanding territorial control). The project was stopped (Delina 2021).

Coal kills. A commemoration of Gloria Capitan (Figure 3). She opposed the construction of coal stockpile facilities as leader of the local anti-coal movement, member of the Philippine Movement for Climate Justice. She was shot on 1st July 2016. She was 57 years old, a grandmother, leader of the Coal-Free Bataan Movement and President of United Citizens of Lucanin Association (Samahan ng Nagkakaisang Mamamayan ng Lucanin), a community-based organization that peacefully opposed the operation and expansion of coal plants and open storage facilities in the Mariveles neighborhood.

After two cases from the Philippines, the following ones, also on coal, are from Japan. They all propose in practice “degrowth of fossil fuels” based on environmental justice. In Japan there are several protests against new CFPP (coal fired power plants) because of a certain “coal renaissance” after the Fukushima disaster of 2011, e.g. citizens’ protests against a two unit CFPP in Yokosuka City in Tokyo Bay deemed to emit 7.26 million tons of carbon dioxide annually (Figure 4). This is developed on the former Yokosuka thermal power plant site that has a 60-year long history in the Kanagawa Prefecture. It will be equipped with two units of 650 MW capacity each, i.e. 1300 MW.

This opposition is paralleled in other locations, for instance in Chiba prefecture against the Soga CFPP of about 1070 MW and is estimated to produce 6.42 million tons of CO₂ per year. Citizens worry that their living conditions get worse in an already polluted area. There is strong support from other groups in Japan concerned with climate change. Notice that the amount of carbon dioxide per year released by the economy of Japan amounts to 1.2 billion tons of CO₂, or almost 10 tons per capita. Keeping Soga CFPP out would represent about 0.5% decrease in emissions for Japan in the absence of “leakage”, i.e. provided this decrease is not compensated by new emissions elsewhere: hence the relevance of NIABY movements (neither here nor anywhere). <https://ejatlas.org/conflict/soga-coal-poer-chiba-japan>.



**JULY 1
IS THE
DAY OF
CLIMATE
JUSTICE
MARTYRS.**
#ClimateJusticeNow

Figure 3. Climate Justice movement against coal in the Philippines. The murder of Gloria Capitan. <https://ejatlas.org/conflict/coal-mining-leading-to-the-killing-of-gloria-capitan>

One could multiply the grassroots instances of opposition to coal (Temper et al. 2020; Roy 2021). Of the many instances in India, I shall show a success in Karnataka in 2008 where climate change was not yet mentioned. The Government decided to implement three CFPP projects of 1000 MW each in Gulbarga, Belgaum and Chamalapura. In August 2007, the Power Company of Karnataka Ltd (PCKL) issued a Global Invitation for Request for Qualification (RFQ), inviting bids for setting up a 1000 MW



Figure 4. <https://beyond-coal.jp/local-activities/yokosuka/>. <https://ejatlas.org/conflict/yokosuka-coal-power-plant>

power plant at Chamalapura. Bids from a number of companies including Reliance Power and Tatas are said to have been received in response to the RFQ. The power plant was proposed to be set up under the BOO (Build, Own and Operate) model, as a public-private partnership and mooted by agencies of the Karnataka government that proposed this 1000 MW coal-fired thermal power plant at Chamalapura, H.D.Kote taluk, Mysore district. This region is of verdant agricultural lands sandwiched between the Kabini and Cauvery rivers, and has a wide network of lakes. The proposed power plant was expected to result in land acquisition of 1200 ha (including 350 ha acres of forest lands) and displace at least 13,000 people, in Chamalapura and its neighboring villages.

In addition to the loss of rich agricultural lands, displacement of people and adverse impact on the ground water table in the region, the CFPP, if set up, would threaten two crucial wildlife habitats – Rajiv Gandhi National Park at Nagarhole is about 14 km away and Bandipur National Park is a mere 30 km from the project site. Right from the beginning, this proposal met with stiff resistance from project-affected people, environmentalists and social action groups. Cutting across socio-economic barriers and urban-rural divide, the agitations were conducted independently by civil society organisations at different levels, with vigils at and around the project site, street demonstrations, *rasta roko* in Mysore, etc. Peaceful protestors were arrested and charged under criminal laws. There were lectures and seminars conducted in Mysore by intellectuals and activists, documentary films, students' protests, meetings organised between village folk and city folk making common cause and explaining the environmental ill-effects of a mega power plant. There were petitions to all levels of government, and a formal petition was made on 19 October 2007, to the Karnataka Electricity Regulatory Commission (KERC), cogently arguing that the project was quite unnecessary and undesirable. People lobbied with elected representatives, and delegations went to Bangalore to argue with government officials and political figures. A significant event was a rally of around 5000 people at the Town Hall in Mysore city centre on 12 September 2007, with leaders of all political parties and groupings excepting, of course, the ruling party at that time. Even some religious leaders lent support to the agitation. And the local media covered all aspects of the agitations. An apolitical alliance of organisations and individuals was formed and named as the Chamalapura Ushnavidyut Sthavara Virodhi Horata Samithi (CUSVHS).

Mysore Grahakara Samiti, filed a petition to the KERC in 2007 to initiate public hearing proceedings on 6 March 2008. The petition was filed to look into the matter of the desirability of establishing 1000 MW CFPP at different places in Karnataka, including one at Chamalapura, Mysore District. Taking cognizance of the submissions made by affected villagers, Gram Panchayat members, social action groups, environmentalists and concerned citizens in the course of the Public Hearing, the KERC in its order dated 19th May 2008, observed that the "bidding process lack(ed) transparency" and was carried out in "an extremely casual manner". As a result of the continued protests, in late 2008, the Karnataka Power Minister announced that the power plant would not be constructed. As a result of this victory, the CUSVHS decided to erect a granite stone table (Vijayagallu) in July 2010, next to a Malleshwara temple on a hill close to Chamalapura (Figure 5).

The engraving on the stone speaks of nature's bounty, its life forms, forest wealth, wildlife and the environment in the same breath as it mentions people. The stone "warns any government of the future not to undertake such destructive, anti-people projects".⁴

Sometimes climate change is the main factor in LFFU movements (as in the Ende Gelände movement in Germany), sometimes it is only an afterthought or is still totally absent as in this Karnataka movement of 2008 (Roy 2021). Let us now look at the recent murder of a woman activist in South Africa complaining against open-cast coal mining threatening her community in Somkhele, KwaZulu Natal. "Leave coal in the hole" could have been her slogan. Coal extraction is certainly not new in South Africa. This is a case of intensification of an existing commodity frontier.

Tendele's coal mine leaves local communities without water. It was denounced by several organizations: the South African Human Rights Commission, WoMin, The Women's Water Assembly, for its human rights and environmental violations. On 22 October 2020, four hitmen shot and killed 63-year-old grandmother Fikile Ntshangase in her home, one more WED (women environmental



Figure 5. Chamalapura, Mysore district.

defenders) murdered around the world (Tran et al. 2020) (Figure 6). Ntshangase was Vice-Chairperson of a committee of the Mfoloji Community Environmental Justice Organisation (MCEJO). It is suspected that the killing was in retaliation for her refusal to sign an agreement with Tendele to cease MCEJO’s court challenges against the mine (Figure 6). <https://ejatlas.org/conflict/tendele-coal-mine-somkhele-kwazulu-natal>.

Russia is a country where coal extraction is increasing. The sixth larger producer after China, the U.S.A., India, Australia and Indonesia although the U.S.A. is decreasing coal production. The Kuzbass is one of the growing areas for coal extraction. Russia seems determined to extract its fossil resources for profit, regardless of the consequences for local and global ecology or for the local population



Figure 6. Keep the coal in the hole (Nov. 5, 2020). Source: Rob Symons. <https://www.iol.co.za/the-star/opinion-analysis/mam-ntshangase-murder-lives-of-human-rights-defenders-whistle-blowers-mustbe-protected-8ee4ef49>

affected by the open coal pits in Kuzbass. There is local opposition. In one recent case, Mencherep farmers in this Kumerovo region successfully resisted a new open coal pit threatening their village. The Belovo regional court in 2018 said the government had no land rights. Residents in the region are suffering from coal dust which is heavily polluting the air, making agriculture impossible and degrading public health. Pollution of water and destruction of landscapes is a daily reality. As so often, less coal extraction implies more social and environmental justice for the citizens and neighbours. <https://ejatlas.org/conflict/mencherep-residents-successfully-resisting-a-new-open-coal-pit-threatening-their-village>.

Finally, another movement against a CFPP in the small island of Jamaica. In February 2017 it seemed that the Chinese company Jiuquan Iron & Steel would build a 1000 MW coal power plant at the Alpart bauxite-alumina factory. This is a conflict on a CFPP and at the same time could become a conflict on bauxite mining. In July 2016 it was reported that the Russian mining company signed a deal for the US\$300-million sale of its 1.6-million-tonne Alpart alumina refinery in Jamaica to China's Jinquan Iron and Steel Company (JISCO). In a separate pact with the Jamaican Government, JISCO agreed to the rehabilitation and expansion of the plant and its conversion to 500,000-tonne-a-year smelter. The inking of the agreements happened in Beijing, where Jamaica's mining minister, Mike Henry, and his energy colleague Andrew Wheatley had talks with Rusal, JISCO, as well as the Development Bank of China. The bank signaled a willingness to commit over several years up to US\$2 billion to the project. An abundance of cheap energy is a critical ingredient in aluminum smelting, and its absence has been a barrier to Jamaica's ambition to convert its bauxite through all the stages to the production of the metal. After 2008, Alpart refinery was mothballed for seven years in face of a soft market for alumina.

Environmentalists said, "No to Coal-Fired Power Plant in Jamaica". More than 21,000 people signed a petition opposing coal-fired power in Jamaica. The #SayNOtoCoalJA initiative, being led by the Jamaica Environment Trust (JET) wanted the government instead to continue the transition to a new energy future for Jamaica, as outlined in many government documents which emphasize energy conservation, renewables and liquefied natural gas (LNG) as a transitional fuel for Jamaica, a nation of 2.7 million people. JET's Chief Executive Officer (CEO) Diana McCaulay. Said: "Coal plant emissions cause respiratory illness in humans and affect the environment by creating acid rain and contributing to global climate change. Coal, in fact, is the dirtiest of the fossil fuels" said McCaulay. "It emits greater quantities of carbon dioxide than other fossil fuels." A modern coal-fired plant emits 762 kg of CO₂ per megawatt-hour of electricity generated, if there is no CO₂ capture. The 1000 MW plant alone would emit roughly 6.7 million tons of CO₂ per year, just over half of Jamaica's 2025 target under the 2015 Paris Agreement on Climate Change. "The building of the proposed coal-fired plant would be in direct contradiction to that agreement", said McCaulay. For his part, Jamaican Energy Minister Andrew Wheatley dismissed the disquiet over reports of the coal plant as much ado about nothing. Meanwhile, it was asserted that

Coal is the only feasible option for a 1000-megawatt power plant being contemplated for the new owners of bauxite alumina company, Alpart. So said former Chairman of the Jamaica Bauxite Institute and Co-Chair of the Energy Monitoring Committee, Dr Carlton Davis. The Chinese-owned Jiquan Iron and Steel, JISCO, was finalizing arrangements to take over Alpart, as part of a planned USD\$2-billion investment in Jamaica. There's been opposition to JISCO's intention to build a 1000-megawatt coal-fired plant to run its operations. But Dr Davis says coal is the only feasible option.

In the end, by November 2017, it was decided however that "It's LNG and not coal for Alpart plant". <https://ejatlas.org/conflict/coal-fired-plant-to-be-built-by-chinese-company-jiuquan-iron-steel-at-nain-st-elizabeth-jamaica>.

Notice that stopping around the world 50 CFPP of 1000 MW each would avoid emissions similar to those of France or Italy, every year. Provided of course there is no "leakage", i.e. the stopped CFPP are not substituted by other sources of CO₂ ("Leakage" is ably discussed in Pellegrini et al. 2021).

4.1.2. Oil and gas related conflicts

The next examples are related to oil and gas. As in many other places, gas and oil fracking is causing conflicts. For instance in Argentina (in the provinces of Río Negro, Neuquén, Mendoza) there has been resistance. Significant deposits of shale oil and gas were discovered in Neuquén province in the Loma de la Lata field in 2010, adding to Argentina's overall shale reserves which were estimated to be the second largest technically recoverable reserves in the world. Argentina's Vaca Muerta shale formation is estimated to hold a large amount of oil and gas. In Loma de la Lata and Loma Campana there have been conflicts over twenty years first with YPF, Repsol, Petrobras and now with Chevron on oil and gas extraction, and fracking. The resistance involves some Mapuche indigenous people (Figure 7). Information on this case in the EJAtlas, <https://ejatlas.org/conflict/resistance-to-chevron-ypf-fracking>, and <https://ejatlas.org/conflict/loma-de-la-lata-neuquen-argentina>.

Allen, Río Negro, is a fruit growing zone, with irrigation, settled by Italian Immigrants decades ago. It belongs to the Vaca Muerta formation that has reached it from its principal main área in Añelo. The government agreement with Chevron was signed in 2013. This is a “commodity widening” and “commodity deepening” process at the same time. There is local resistance. <https://ejatlas.org/conflict/allen-y-la-extraccion-de-gas-por-fractura-hidraulica>

Very far from Argentina, in the Lofoten islands off the coast of Norway, success was reached in the attempts to “leave oil in the ground”, estimated at about 1.3 billion barrels, equivalent to about 175 million tons. For many years there was a debate on whether to get oil from the biodiversity-rich Lofoten islands. By 2019 the question is temporarily settled. The forward march of the Norwegian oil-extractive economy to new commodity frontiers continues elsewhere. The Lofoten archipelago is a highly biodiverse area that holds cold-water reefs, pods of sperm whales and killer whales. It has some of the largest colonies of seabirds in Europe and it is the spawning grounds of what is deemed to be largest cod stock in the world. After years of civil society efforts, by 2019 the alarm at climate change meant that the Labor Party, the country's biggest force in Parliament and a long-time backer of the oil industry, decided to stop pushing for oil exploration in the sensitive Lofoten islands <https://ejatlas.org/conflict/oil-drilling-lofoten-norway>

To stop pipelines is often an objective of local environmental movements reinforced by global concerns about climate change. The word “Blockadia” was born in these encounters in North America (the U.S.A. and Canada), often involving indigenous population (Temper 2019). Thus Sioux complained against the Dakota Access Pipeline (DAPL), U.S.A., arguing that “water is sacred” and therefore economic compensation is not the issue. The DAPL, with the Standing Rock famous



Figure 7. Against Chevron's fracking in Neuquén, Argentina. Source: Confederación Mapuche de Neuquén.

protest, would be connected to the Keystone XL pipeline, a network of pipelines that would carry oil from the Canadian tar-sands in Alberta to refineries in the U.S.A.. The DAPL is an 1886 km oil pipeline that would transport nearly 500,000 barrels of crude oil a day (25 million tons per year) from North Dakota to Illinois, where it would be shipped to refineries (Figure 8). 25 million tons of oil per year, when burned, would produce approximately 75 million tonnes of CO₂ (See <https://ejatlas.org/conflict/dakota-access-pipeline> and <https://ejatlas.org/conflict/210000-gallon-oil-spill-from-keystone-pipeline-in-south-dakota>).

According to Vival Monga in *The Wall Street Journal*, 21 Jan. 2021, President Biden's decision to revoke a permit for Keystone XL spells the end of a saga spanning more than 12 years over the pipeline Keystone XL, an expansion of an existing pipeline, called Keystone, that carried already Canadian crude into the U.S. Keystone XL was first proposed in July 2008 by TC Energy Corp., then known as TransCanada Corp., based in Calgary, Alberta, and ConocoPhillips which was a joint owner until 2009. The expansion was originally conceived when oil prices were at historic highs – just before the 2008 financial crisis and American shale oil boom – as an artery that would pump Canadian crude more than 1700 miles from Alberta to the U.S. Gulf Coast. See <https://ejatlas.org/conflict/keystone-xl-in-nebraska>

Another case of Blockadia opposition in North America, also with origin in the Alberta tar sands (and very fully reported in the EJAtlas by Carol Voss) affects the Kinder Morgan Trans Mountain Pipeline Expansion, a USD 3.5 billion dollar project that would establish a new pipeline twinning an existing pipeline from Strathcona County, Alberta to Burnaby, British Columbia. In 2018, more than 240 people were arrested in Burnaby, BC, Canada for disrupting the expansion of the Trans Mountain Pipeline (Figure 9).

There are similar pipeline cases elsewhere. For instance, in Southern Italy *Né qui né altrove* is the translation of NIABY (not in anyone's backyard) into Italian. NIABY is commonly used by the environmental movements elsewhere as a reply to NIMBY framings (Figure 10).

In Puglia they have fought to protect land and community from the Trans Adriatic Pipeline (TAP). They want to stop the circulation of gas. This pipeline and terminal threatens ancient olive farms, water sources, cultural heritage sites and a stunning coastline. It is part of the larger project



Figure 8. The DAPL. Source: Arlo Iron Cloud.



Figure 9. <https://ejatlas.org/conflict/mencherep-residents-succesfully-resisting-a-new-open-coal-pit-threatening-their-village>

called the Southern Gas Corridor carrying gas to Europe which includes the Trans Anatolian Pipeline (TANAP) and the Trans Caspian Gas Pipeline.

Italian best-known “No” movements are currently No Tav, No Tap, No Muos, No Ponte, No Grandi Navi, No Triv, Mamme No Inceneritore, all born at particular locations but with wide reach. They are respectively on the very material issues of the new rapid railway line between Turin and Lyon, the gas pipeline in Puglia, the Mobile User Objective System (a military satellite communications system promoted by the U.S. government in Niscemi, Sicily), the bridge over Messina Strait, the nuisance from the enormous cruise ships in Venice waters (at least until 2020), the off shore oil drilling, the waste incineration (Bertucci 2019). Some of them are directly related to fossil fuels and therefore climate change, others only indirectly.



Figure 10. Against the TAP in Puglia. Source: Movimento No TAP.

Oil and gas conflicts at the extraction and transport frontiers are not always played out relatively peacefully as the ones we have seen in this section in Argentina, Norway, Canada, U.S.A., Italy, with some people arrested and an occasional mortal victim here and there. Oil and gas have caused wars. A brutal encounter around the 20 billion USD project in Cabo Delgado, Mozambique took place as this article was finished in 2021. Total, the French fossil fuels firm, was forced to suspend work at the Afunge airport and gas terminal. The background was already visible in entries in the EJAtlas and elsewhere.⁵ The awful events at Palma, a town on the coast of Mozambique immediately south of the border with Tanzania, happened because this is the base of LNG operations for the growing offshore Mozambique natural gas industry. Although initially community relocation seemed successful (Symons 2019), the gas project leads to major local changes and violence, evicting and displacing farming and fishing communities who lost their livelihoods, giving major incentives for the youth to join Islamist rebel groups. Over half the population of Cabo Delgado is Muslim. This is a case of enclave or “bunker” extractivism where Total hopes with Mozambican and foreign troops to secure about 7000 hectares. In March 2021 South African mercenary military security flying helicopters battled the Islamist insurgents. What will be the price of this colonial natural gas? (Amis de la Terre 2020). Now in 2021 a terrestrial and naval “counter-insurgent” army with Portuguese, U.S.A., South Africa and other forces is being organized to secure gas extraction and export from this commodity extraction frontier (Figure 11). See <https://ejatlas.org/conflict/afungi-lng-construction-site> and <https://ejatlas.org/conflict/cabo-delgado-communities-impacted-by-gas-exploration-projects>.



Figure 11. The LNG extraction plans at Cabo Delgado. Source: Total.

A report from Justiça Ambiental of 2020 had warned that the situation would be comparable to the Niger Delta, and also to Tete province in Mozambique itself:

Unfortunately, it seems Cabo Delgado is heading down the disastrous path of the province of Tete, where the government handed some 60% of local land in concessions to the coal industry. Exploration and mining in the province have resulted in the forceful displacement of over 1,300 families and led to major loss of livelihood for local communities and extensive pollution. Locals have reported deaths of people and animals due to polluted water.⁶

Three multinationals control the gas in Cabo Delgado – ENI (Italy) the far offshore section, Exxon-Mobil (U.S.A.) the middle section, and Total (France, taking over from Anadarko) the section close to the coast. So far, work has begun on only a small part of the dreamed gas bonanza. The Total CEO told President Filipe Nyusi personally that Total would continue only if Mozambique would guarantee security in a 25 km cordon around the gas project on the Afungi peninsula.

Another large conflict although perhaps less costly in terms of human lives, is brewing up in Southern Africa in Namibia and Botswana. A Canadian company is drilling exploratory wells in Namibia for what could be a major oil and gas find. Local residents and conservationists fear the project could use up scarce water supplies and cause widespread ecological disruption downstream in the world-renowned Okavango Delta. They also fear that the development could damage traditional sites of the San, the Indigenous people in Namibia and Botswana. Reserves are estimated at between 12,000 million and 120,000 million barrels of oil. Exploration licenses comprise over three million hectares. ReconAfrica's plans are located in the regions of Kavango East and Kavango West which are home to 200,000 people — including the indigenous San — making a living from farming, fishing, and tourism. A network of rigs, pipelines, and roads would sprawl across an environmentally sensitive, semi-arid region that is home to Africa's largest remaining population of savanna elephants as well as numerous threatened or endangered wildlife species. In addition, the drilling — which may involve hydraulic fracturing, or fracking — also would encompass or border national parks and wildlife conservancies, and could threaten waterways that local communities rely on and that eventually flow into the renowned Okavango Delta, a UNESCO World Heritage Site.⁽²⁾ (Figure 12). Oil drilling in Kavango provinces in Namibia and in Botswana. The Kavango Basin, which spans northeastern Namibia and northwestern Botswana, is part of the Kalahari Desert. In an

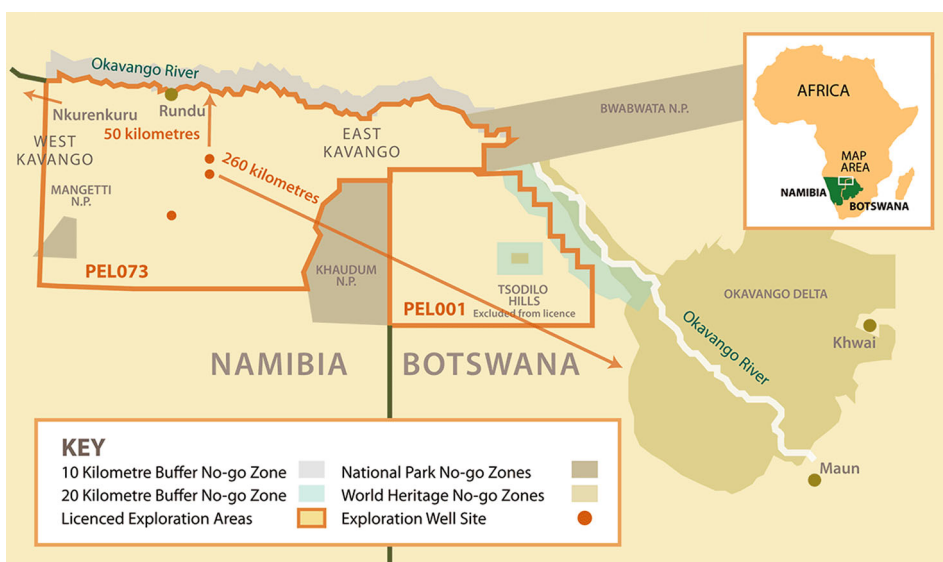


Figure 12. Oil drilling in Namibia-Botswana. Source: ReconAfrica. <https://ejatlas.org/conflict/kavango-oil-botswana-namibia>.

otherwise dry environment, the Okavango River (known in Namibia as the Kavango) is a lifeline, flowing from the highlands of Angola, through northern Namibia, and emptying out into the Okavango Delta, in northwest Botswana. Environmentalists and community leaders want to see the area preserved. They have teamed up to raise awareness about the matter. A campaign called #SavetheOkavangoDelta was started by Fridays for Future Windhoek and Frack Free Namibia and Botswana, two local environmentalist groups. A protest was organised in Windhoek, the capital, the week before the drill rig arrived in December 2020. Due to COVID-19 pandemic restrictions, most other efforts have been organized online. An online petition appealing to the governments of Namibia and Botswana garnered more than 150,000 signatures. “Who gave the government the right to determine the destiny of Indigenous communities? This is just another case of environmental racism,” Ina-Maria Shikongo, the founder of Fridays for Future Windhoek, told Al Jazeera. “My worst fear is that it could turn into a new Niger Delta,” Shikongo added (Figure 12).

5. Discussion and conclusion: “degrowth in practice” from the supply side

Fifty years ago Georgescu-Roegen published *The entropy law and the economic process* (1971). He coincided with other authors before and after him (cf. Martínez-Alier and Schlüpmann 1987) when insisting at length on the fact that the industrial economy is not circular but entropic. This explains the growth of conflicts at the extraction, transport and waste disposal frontiers because energy is dissipated and only some materials are recycled. This is lesson number one in a course of ecological economics and political ecology.

Hunter-gatherers and agriculturalists had indeed lived by current photosynthesis. Ecological anthropologists (Rappaport 1968; Lee 1979; Love and Isenhour 2016) calculated the sustainable energy return to human energy input. Pre-industrial agriculture had a favourable EROI (energy return on energy input) compared to modern industrial agriculture (Martínez-Alier 2011). With industrialization and fossil fuels, the world economy became more and more entropic. At world level, of all the materials entering the economy (fossil fuels, building materials, metal ores, biomass), by 2005 only about 6% were recycled (Haas et al. 2015). The low degree of circularity has two main reasons. First, 44% of processed materials were used to provide energy and are thus not available for recycling. Second, socioeconomic stocks were growing at a high rate with net additions to stocks of 17 Gt/yr. The expansion of stocks (the “built environment”) requires first a rising input of materials and energy; and once in place, a persistent input of materials and energy is needed for their maintenance and operation (Haas et al. 2020). These numbers illuminate the way through the jungle of words enacting the miraculous coming of a “circular economy” whether by virtue of the Chinese law for the promotion of the circular economy of 2009 or by the many directives from the EU Commission in Brussels. As China kept increasing coal mining in its internal extraction frontiers of Shanxi and Shaanxi provinces as well as Inner Mongolia supplemented by imports and by Belt and Road financing of fossil fuels extraction overseas, one could wonder what the government meant by a “circular economy” in 2009.

Our focus is the local opposition to fossil fuels extraction, transport and burning to which climate change arguments are added (Martínez-Alier et al. 2016). LFFU is promoted by local communities (Sarayaku in Ecuador is one of the best known) confronted by national or foreign extractive industries. Sometimes it is supported by external environmental organizations, religious groups, scientists and professionals. This article brings together several environmental social sciences, focusing on the issue of “leaving fossil fuels underground” (LFFU). First, the study of social metabolism in ecological economics and industrial ecology which provides the evidence for the low degree of circularity of the industrial economy. Environmental conflicts are exacerbated by the need for new materials which outstrips recycling, creating a widening, huge metabolic rift or “circularity gap” (a chasm more than a gap) that requires expansion and intensification of existing extractive and waste disposal sites. Second, the concept of “commodity frontiers” is brought into the analysis. It comes from environmental and economic history, the places where the “fresh” material and energy input for

the industrial economy come from. The concept of “waste disposal frontiers” is also pertinent (Schindler and Demaria 2020). Third, political ecology is deployed as the study of environmental conflicts, which I call “ecological distribution conflicts” (EDC) to emphasize that they are not only economic in nature (in the chrematistic sense of “economic”). The participants in such EDCs exhibit incommensurable values. Such plurality of values is a fundamental tenet of ecological economics. Adding finally an element from the environmental humanities, I have drawn on the iconography and art-activism (Serafini 2019) accompanying conflicts as gathered in the EJAtlas. The visible iconography of environmental demonstrations (banners and murals) helps combat the agnotology of environmental protests in the media and in academia.

I started by explaining why the industrial economy is not circular. It is entropic. In the last 120 years, the human population grew five times (from 1.5 to 7.5 billion, probably stopping at 9.5 billion by 2060) while the inputs processed in the global economy (biomass, fossil fuels, building materials, metals) grew approximately thirteen times, from 7.5 to 95 Gt per year (Haas et al. 2020). The economy is becoming less and less circular. The industrial economy dissipates fossil fuels energy and discards materials, it is entropic and therefore it goes to the frontiers of commodity extraction and also the frontiers of waste disposal causing damages and conflicts. The extraction of fossil fuels continues and even grows, as also excessive carbon dioxide emissions. Coal, oil or natural gas burned today are no longer available; tomorrow the industry will reach a new extraction frontier. Could be Alaska or Yamal peninsula in the Arctic, could be Cabo Delgado in Mozambique or Vaca Muerta in Argentina. Solar and wind energy are added to other sources (coal, oil, gas, also hydropower, biomass and nuclear), they do not yet substitute for them. The new sources produce their own conflicts because of land and minerals requirements (Avila 2018; Temper et al. 2020; Levenda, Behrsin, and Disano 2021). Meanwhile, India is making progress in her *transition to coal* (Roy and Schaffartzik 2021) while China has been financing many CFPP also outside China. The geo-engineering experiments (Hamilton 2013) give hope to “eco-modernists” but they might cause new conflicts. To some analysts, green capitalism seems a trendier topic of critique than brown capitalism. They are more intrigued by the tricks and ploys of carbon credits and trade, the rare earths, the promises and threats of green energy than by the “boring” existing industrial metabolism based on coal, gas and oil extraction, the digging of sand and gravel for the cement industry (Bisht 2021), the mining of iron ores, copper, bauxite, nickel, titanium ores; the sprawling eucalyptus, sugar cane and oil palm plantations, and the CAFOs (concentrated animal feeding operations).

EDCs arise concomitantly to the growth and changes in the current social metabolism (Roy and Martínez Alier 2019, 2021). Some are born from the use of fossil fuels and other materials. Other EDCs might also arise when attempts are made to narrow the “metabolic gap” or “circularity rift” by introducing forms of energy different from the fossil fuels (hydropower, “biofuels”, nuclear, wind-mills, photovoltaic), when new or old metals are mined at the commodity extraction frontiers for the electricity transition (lithium, cobalt, nickel, copper), or by the current plunder of light balsa wood by Chinese firms in the Amazon of Ecuador or polluting instances of local recycling of metals damaging health – e.g. in Pizhou in China⁷ and in Oroya, Perú.⁸

There are also many EDCs arising from the materiality of the communications industry – not only the old search for paper pulp and the local fights against tree plantations but the new reliance of the media technologies on the extraction of minerals such as coltan and others, the dumping of electronic waste (which is only in part recycled), and the use of great amounts of electricity (Parikka 2015).

My book *The Environmentalism of the Poor* (2002) studied the environmental resistance of the global poor and indigenous at the frontiers of commodity extraction and waste disposal. Such conflicts imply “valuation contests”. EDCs are often not about different valuations within a single measure of value (such as how many dollars will measure an “externality”?) but rather about incommensurable values. To impose a single measure of value (such as dollars) is nothing else than an exercise in political power.

In this paper, I have not analysed all types of EDCs focusing instead on a selection of complaints against extraction, transport, and burning of fossil fuels leading to LFFU proposals.⁹ They often but not always combine local reasons with the global alarm at climate change. A movement from the South claiming an ecological debt for climate change, and putting forward proposals for leaving the “unburnable fuels” in the ground was born in the 1990s out of the many EDCs related to fossil fuels, and in particular by the bitter experience for decades in the Amazon of Ecuador and the Niger Delta in Nigeria. This is part of the world movement for environmental justice. The protestors are indigenous and relatively poor people in some instances, or middle class and professional people in other instances (as in Japan). They belong to or are supported by local EJOs and sometimes by international EJOs. Climate-change-related protests are more likely to attract international EJOs than purely local environmental protests about the dispossession of land and water access rights. In 2021 a Goldman Prize was awarded to Kimiko Hirata of the Kiko network in Japan for contributing to stop a wave of construction of CFPPs avoiding emissions of forty million tons of carbon dioxide per year while in September 2021 it was optimistically reported that Indigenous resistance to fossil fuel projects in the United States and Canada in the form of Blockadia movements against more than twenty fossil fuel projects (such as pipelines) have stopped or delayed greenhouse gas pollution equivalent to at least 25 percent of annual U.S. and Canadian emissions. (See <https://grist.org/protest/indigenous-resistance-has-cut-u-s-and-canadas-annual-emissions/>).

In the EJAtlas as a whole, the success rate in environmental protests reaches 17%, generally meaning “project stopped”. The rest are “failures” and “don’t knows”. The success rate is similar for the 612 fossil fuel conflicts registered, of which 90 are deemed as successes (30 April 2021). Local complaints against fossil fuels (and also against many other investments that indirectly increase GHG emissions) contribute, if successful, to climate justice locally and globally. They prevent local damages and they avoid GHG emissions. Sometimes self-consciously, these grassroots movements motivated by local grievances have the result, when successful, of leaving many tons of carbon from coal, oil and gas underground preventing them from turning into CO₂ (or methane) in the atmosphere. However, there are many different issues involved in such protests that cannot be reduced simply to accounting in terms of tons of GHG – or in money terms-, such as avoidance of oil spills, mining accidents, coal dust, pneumoconiosis (Liu 2021).

Our hypothesis (Temper et al. 2020; Roy and Schaffartzik 2021) is that the many grassroots LFFU complaints are indeed an effective socio-environmental strategy of “carbon captured” – as Oilwatch proclaimed in 1997. Leaving the estimated 850 million barrels of oil in the soil of the Yasuni ITT in Ecuador would have prevented emissions over the life of the project (about 25 years) of about 400 million tons of carbon dioxide (when burned) roughly equivalent to half of those of Germany per year. The Yasuni ITT field holds an amount of oil comparable to the Lofoten Islands. Leaving the Yasuni ITT oil in the ground would have meant an economic sacrifice for Ecuador and even for some local populations, but it would have benefitted other local populations and certainly the local and global biodiversity. On its side, foregoing 50 million tons of LNG per year in Cabo Delgado would damage Total’s financial results but would avoid emissions similar to those of burning 60 million tons of oil per year, approximately 1.2 million barrels per day. Producing LNG is energy-intensive, and the LNG produced will eventually be burned in the importing countries. Stopping the operation would avoid emissions of about 150 million tons of CO₂ per year.

Meanwhile, as we have noticed, an efficient 1000 MW CFPP will emit into the atmosphere roughly 6.5 million tons of CO₂ per year. Many CFPP are locally challenged because they also emit sulphur dioxide, nitrogen oxides and particulates affecting the local populations. World emissions of carbon dioxide are of the order of 40 billion tons per year (35 from fossil fuels, 5 from land use changes). They exceed the ability of the oceans and new vegetation to absorb them. They must be reduced by half. The power from all world CFPP is approximately two million MW. Putting all the effort on coal (and none on oil and gas), stopping one thousand CFPP of 1000 MW would imply a substantial 6.5 billion tons of CO₂ avoided, 18% decrease of world emissions per year. In

our brief survey of CFPPs we have seen several cases of success in stopping them. There are many more in Temper et al. (2020) and in Roy (2021).

In conclusion, a ball-park estimate of the potential of LFFU struggles (on coal, oil and gas) if that a grassroots supply-side decrease of 10% per year in CO₂ emissions with respect to the 35 billion at present is currently feasible. Or, equivalently, 20% of the reduction that must be done. Provided of course the decrease is not compensated by new carbon dioxide producing investments.

Thus, leaving fossil fuels underground (LFFU) through bottom-up movements could make an encouraging supply-side contribution to the required decrease in carbon dioxide emissions and moreover have other side benefits. This could be complemented by demand-side policies such as emissions quotas by country and carbon taxes. No automatic “leakage” (conflict-free substitution by other fossil fuels projects), is to be expected. This substitution might take place or not. In the Jamaica CFPP case, we have seen that natural gas will substitute for coal. If there is no “leakage”, then there would be “degrowth in practice” through de-facto alliances between the Degrowth movement and the Environmental Justice movement (Martinez-Alier 2012). The local complaints have a multiplicity of expressions and social actors but there are structural roots to all of them: the industrial economy unavoidably marches to the commodity extraction frontiers because energy is not recycled and materials are recycled only to a small extent. We are firmly stuck into an entropic industrial economy, faced by an enormous circularity gap. The entropy causes conflicts, while the attempts to make the economy less entropic might cause other conflicts. It is the task of ecological economics and political ecology to reveal such connections.

Notes

1. See the document ‘Explore the Circularity Gap Report 2021’, <https://circularity-gap.world/2020> retrieved on 25 March 2021.
2. Residents of a small Alaskan village voted in 2016 to relocate their community from a barrier island that has been steadily disappearing because of erosion and flooding attributed to climate change: <https://ejatlas.org/conflict/climate-change-displacement-of-native-alaskans-usa>
3. There are a few hundred such LFFU cases in the EJAtlas and more in reality (Temper et al. 2013, 2020; Roy 2021). For a previous approximation, our 2017 EJAtlas Blockadia featured map with 70 cases <https://ejatlas.org/featured/blockadia>, reviewed in <https://phys.org/news/2017-11-blockadia-reveals-global-scale-anti-fossil.html>. Also Martínez-Alier et al. (2018).
4. Sources: <https://www.thecitizen.in/index.php/en/NewsDetail/index/4/19737/A-Victory-Cast-in-Stone>. <https://ejatlas.org/conflict/chamalapura-thermal-power-plant-karnataka-india> (Swapan Kumar Patra).
5. <https://ejatlas.org/.../cabo-delgado-communitites-impacted> ... Also the short article by Patrick Bond and J. Martinez-Alier (2021), Was the Cabo Delgado massacre a curtain call for Mozambique’s methane capitalism? <https://countercurrents.org/author/joan-martinez-alier/>
6. Ilham Rawoot. Gas-rich Mozambique may be headed for a disaster. The extractive gas industry in Mozambique has done more damage than good for Mozambicans. Febr. 2020. <https://www.aljazeera.com/opinions/2020/2/24/gas-rich-mozambique-may-be-headed-for-a-disaster?fbclid=IwAR1XQTHRfCtvL4ctFisadoxoHoZyaUYrqnV8EQxfMrVwDdElqDG8SnX4ol>
7. Lead poisoning by Jianguo Chunxing, Pizhou, China (<https://ejatlas.org/conflict/lead-poisoning-by-jianguo-chunxing-pizhou-china>).
8. La Oroya, Peru (<https://ejatlas.org/conflict/la-oroya-peru>).
9. Cf. the University of Amsterdam project with Joyeeta Gupta et al <http://www.leavefossilfuelsunderground.org/wp-content/uploads/2018/07/Brochure-LFFU.pdf>

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